# Recurrent injury patterns in adolescent rugby

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**Abstract**

**Objectives** To establish patterns of subsequent injury in U18 rugby, to quantify the burden of within season injury recurrence.

**Design** Secondary analysis of prospective data

**Setting** 28 Schools in Ireland

**Participants** 825 male rugby players (aged 15-18 years)

**Main outcome measures** Subsequent injuries were classified as: new, local or recurrent (same site and type as index injury). All recurrent injuries were sub-grouped by body part and diagnosis. Burden was based on frequency, days lost and injury proportion ratios.

**Results** A total of 426 injuries were eligible for analysis, of which, 121 were subsequent injuries. The majority of subsequent injuries involved a different body part than their index injury. There were n= 23 cases of within season recurrence. 78% of recurrences occurred within 2 months of return to play. Recurrent injuries comprised 5% of all injuries and their cumulative time loss was 1073 days. Recurrent injury to the ankle ligaments, lumbar muscles and concussions carried the greatest burden.

**Conclusion** The burden of recurrent injury in U18 rugby is lower than in the professional game. However, this population could benefit from targeted secondary prevention efforts including reconsideration of return-to-play protocols for ankle sprain, lumbar muscles and potentially concussion.

**Key words**

Rugby, adolescent, youth, recurrent injury

## Introduction

Rugby Union is the third most common contact sport in the world. It is played by over 2.5 million people in the UK and Ireland, with over 700,000 registered teenage players.(1) Rugby Union is a fast paced, collision sport and therefore carries a high risk of injury. A recent meta-analysis of professional rugby estimated an injury incidence of 81 per 1000 player hours.(2) Recently more epidemiological data has become available from adolescent players, with meta-analyses suggesting an incidence rate of 26.7 per 1000 player hours.(1, 3) Although these figures are lower than in professional populations, there are similarities in injury pattern with both adolescent and elite cohorts at highest risk of head, shoulder and knee injuries, particularly during the tackle situation. (4, 5)

Sports injuries are often recurrent and there is much evidence that a subsequent injury is associated with a previous injury. (6, 7) Subsequent injuries are often classified as (1) New: different site; (2) Local: same site (and different type); or (3) Recurrent: same site and type.(8) An eight season prospective study in elite rugby union in Australia found that 70% of subsequent injuries were 'new' injuries, with 14% classified as local and 16% recurrent.(9) Interestingly, the majority of recurrent injuries involved the ankle and neck regions, and many occurred early, within 2 months of returning to play.(9) Patterns of subsequent injury have not yet been extensively evaluated in adolescent Rugby Union players. A recent systematic review of rugby injuries in players aged <21 years did not report data on subsequent injuries.(1) However, a preliminary report(10) from 7 schools in England suggested that 11% of rugby injuries occurring within a single season are recurrent, and that these injuries are associated with greatest time loss.

High levels of recurrence increase the immediate burden of sports injury but may also have a deleterious impact on long term health. A key concern is that adolescent rugby players are at particular risk of subsequent and recurrent injury due to the limited access to professional medical care. The purpose of this research was to establish patterns of subsequent injury in adolescent rugby union. Our primary objectives were to quantify the burden of within season injury recurrence and to subgroup based on body part and diagnosis.

## METHODS

This is a secondary analysis of prospectively collected epidemiological data from the RISUS study (Rugby Injury Surveillance in Ulster Schools).(5) Ethical approval was obtained through the X Ethics Committee (REC/14/0060) and individual consent was obtained from participants and their guardians. The study methods have been described in full detail elsewhere.(5) Briefly, eligible teams were those participating in a provincial schools' cup competition. Individual participants must have been members of their schools' first team squad. In total, 825 players, from 28 schools, were included over a single season. The average number of players recruited from each school was 27 (SD 6.3). All participants were male with mean age of 16.9 years (SD 0.8; range 15-18y), mean weight of 78.8 kg (SD 12.3) and mean height of 1.78 m (SD 0.07).

**Data collection and definitions**

The following information was inputted for each injury: the date of injury, classification of the injury at two levels (body site, type of injury), information on the injury event, and the date of return from injury. Injury reporting was completed each week by a designated person at each school (data champion), directly onto an online data system. All definitions and procedures used in the study aligned with the international consensus statement on injury surveillance studies for rugby.(11) The primary injury definition used was for time-loss injuries, which was defined as 'any injury that prevents a player from taking a full part in all training and match play activities typically planned for that day for a period of greater than 24 h from midnight at the end of the day the injury was sustained'. Injury severity was based on the total number of days elapsed from the day of injury until a player returned to full fitness, with full fitness being defined as 'the player being able to take a full part in training activities typically planned for that day and available for match selection'. Injury severity was classified according to the following subgroups: minor (1–7 days), moderate (8–28 days) and severe injury (>28 days).

**Analysis**

Over a single playing season, the RISUS study prospectively recorded 426 injuries. For this post hoc analysis, players' injuries were ordered sequentially according to the date of their occurrence to determine the first index injury and any subsequent injuries.(12) Subsequent injury was defined to have occurred in the subset of players with two or more reported injuries in the 2014/15 playing season. When players sustained two injuries, the first chronological injury was taken as the index injury. When players suffered multiple injuries (>2) within the same season, each injury was examined and if applicable, players were assigned additional unique index injuries. All subsequent injuries were then labelled according to body part and diagnosis before being categorised into one of the following categories: new (involving a different body region to the index injury); local (involving the same body region as the index injury, but with a different diagnosis); or recurrent (involving the same body region AND diagnosis as the index injury).(8)

Our primary analyses were on those subsequent injuries categorised as 'recurrent'. Time to recurrence was summarised and plotted using a survival curve. Time to recurrence was also dichotomised to facilitate comparisons to previous research, whereby recurrent injuries occurring within 2 months after return to full participation from the index injury were defined as 'early' and >2 months as 'delayed.(9) Recurrent injuries were also sub-grouped according body part and diagnosis. Burden was reported as the number and proportion of total injury days lost due to recurrent injury. Wilcoxon Signed-Ranks Test and calculation of effect size was used to compare the time loss associated with recurrent injuries vs index injuries. For each recurrent injury, we calculated separate injury proportion ratios (IPR); this compared the proportion of recurrent injuries that were 'eg. concussions' and the proportion of new injuries that were concussions. Below is an example of how IPRs were calculated: (13)

IPR = number of recurrent concussions / number of recurrent injuries
number of new concussions / number of new injuries

All statistical analyses with SPSS software (V.22.0; SPSS, Chicago, Illinois, USA).

**Results**

Figure 1 outlines the number of subsequent injuries occurring in a single season of adolescent rugby. 63% of players (521/825) were uninjured, with the remaining 37% (304/825) suffering at least one injury during the season, with 11.5% suffering multiple injuries (2 or more). A total of 426 injuries were eligible for analysis, of which, 121 were subsequent injuries (28.4%). 76% of subsequent injuries were considered new as they involved a different body region to the index injury (92/121); 19% (23/121) were recurrent, involving the same body region and diagnosis as the index injury; and 5% (6/121) were local, involving the same body region as the index injury, but with a different diagnosis.

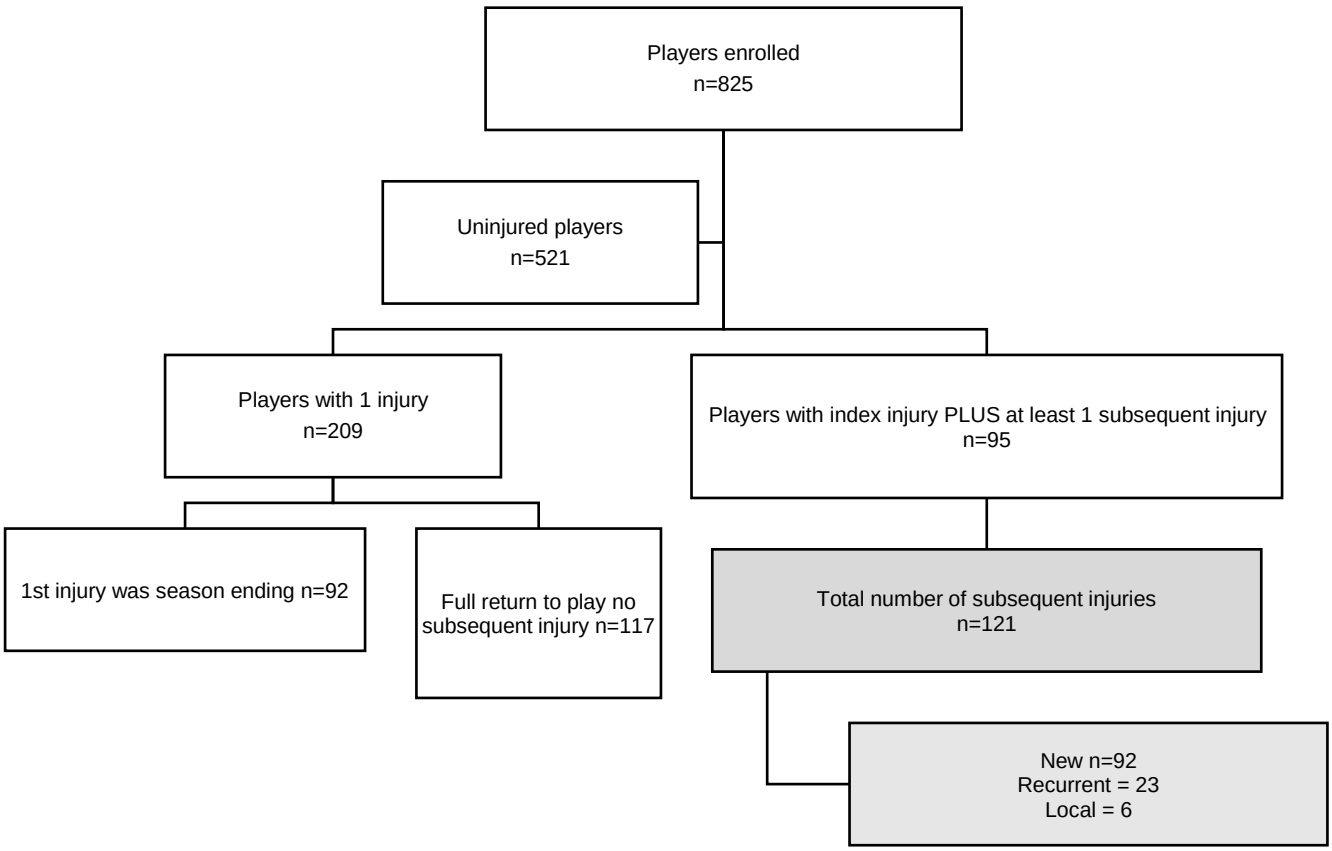



**Figure 1**. **Classification of subsequent injury into new, local and recurrent**

**Time to Recurrent Injury**

Figure 2 shows the time from return to play until recurrent injury. 78% (18/23) were early recurrences, occurring within 2 months after return to full participation. The median time-interval for a recurrent injury to appear was 18 days after full return to play (mean 35.6, SD 40.5, range 1-140 days).

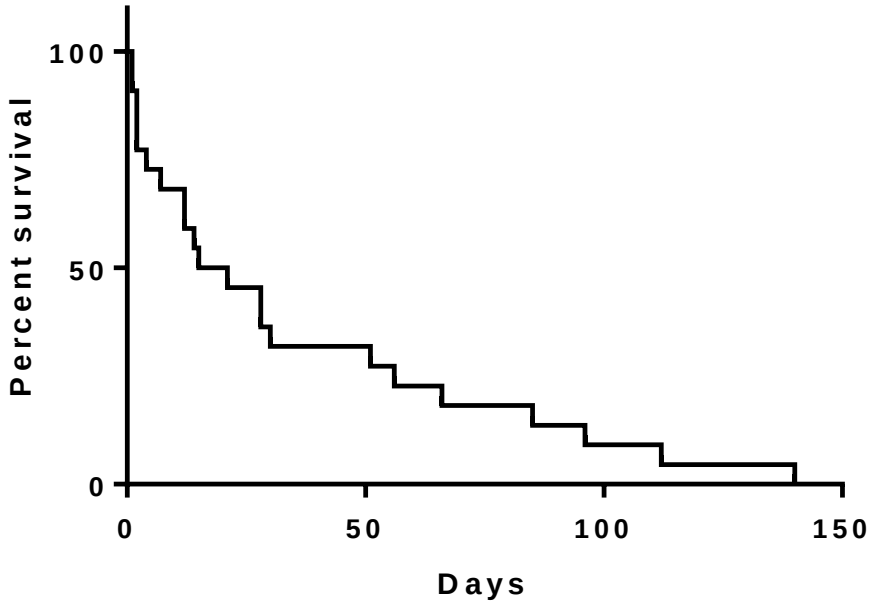



**Figure 2 Time from return to play to recurrent injury (n=23)**

**Recurrence Patterns**

Table 1 subgroups recurrent injuries (n=23) according to body part and diagnosis. The foot/ankle (22%), head (17%) and shoulder regions (13%) were the most frequent locations. Ligament tears/partial tears (sprains) (52%), muscle tear/partial tears (strains) (26.1%), and concussion (17%) were the most frequent type of recurrent injury.

**Table 1. Injury recurrence by body part and diagnosis**

| | **Frequency N (%) ł** |
|---|---|
| **Body Part** | |
| Head / face | 4 (17.4%) |
| Clavicle/shoulder | 3 (13.0%) |
| Hand/finger/thumb | 2 (8.7%) |
| Lower back | 3 (13.0%) |
| Hip/groin | 1 (4.3%) |
| Posterior thigh | 1 (4.3%) |
| Knee | 3 (13%) |
| Lower leg/Achilles | 1 (4.3%) |
| Ankle/Foot | 5 (21.7%) |
| **Diagnosis** | |
| Ligament tear/partial tear (sprain) | 12 (52.2%) |
| Muscle tear/partial tear (strain) | 6 (26.1%) |
| Concussion | 4 (17.4%) |

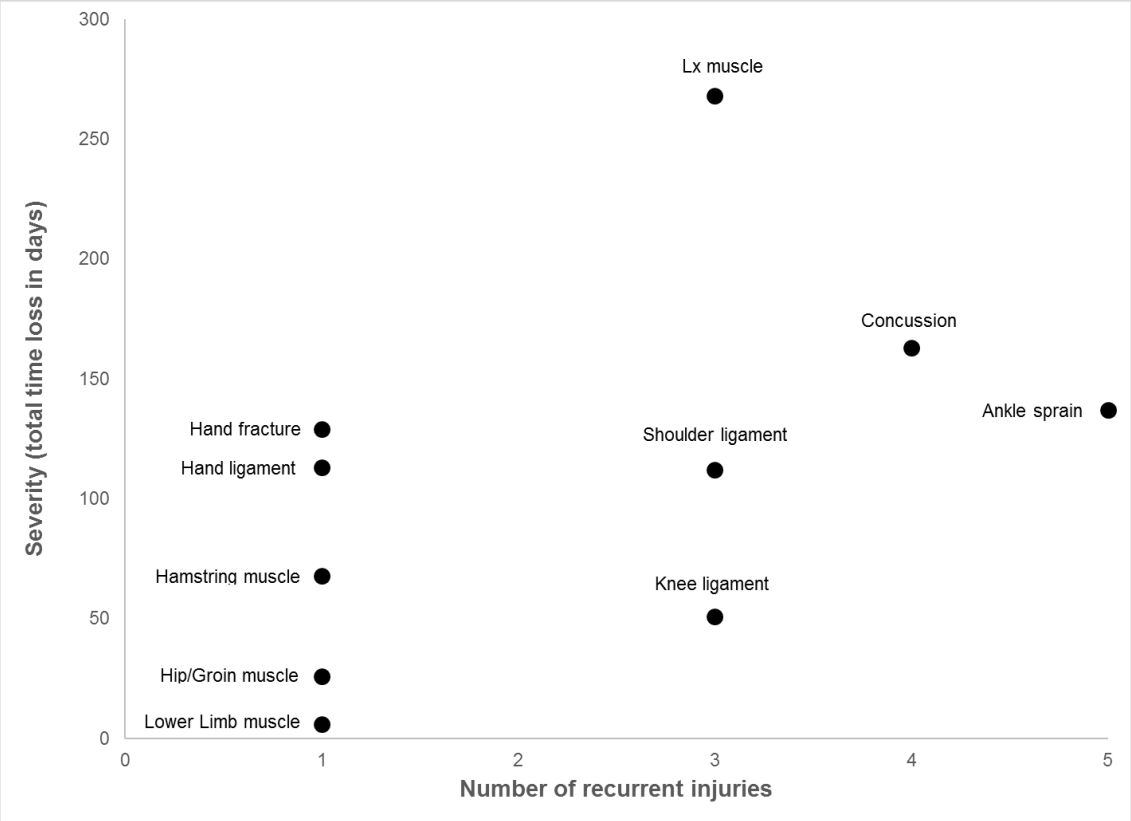
| | |
|---|---|
| Fracture | 1 (4.3%) |

ǂ Frequency presented as no. and percentage of total no. of recurrent injuries

**Burden of recurrent injury**

There were 23 recurrent injuries across 28 schools which equates to 0.8 recurrences per school per season. The cumulative time loss due to recurrent injury was 1073 days. 22% (5/23) of recurrent injuries were minor and resulted in <8 days of time loss. 35% (8/23) were moderate, incurring 8-28 days of time loss. The remaining 43% (10/23) were severe (>28 days of time loss). Recurrent injuries fell into 10 specific diagnoses. Figure 3 outlines the burden of injury by matching the number of recurrences with the total days lost by diagnosis. Recurrent injuries involving the lower back muscles, concussion and ankle ligaments incurred the greatest burden.

Paired comparisons found trends that recurrent injuries were associated with greater time loss injuries (mean 44.7, SD 48.0; median 23 days, IQR 53.5) than their index injuries (mean 24.3, SD 19.0; median 21 days, IQR 24) but this was not statistically significant (E.S 0.6; p =0.39)




Muscle = muscle tear/partial tear/strain; Ligament = ligament tear/partial tear/sprain

**Figure 3. Burden of recurrent injury: Number of recurrences by total time lost for each diagnosis**

Table 2 summarises the IPRs for each diagnosis**.** Muscle strains involving the lumbar spine or lower limb rarely occurred, but both these diagnoses had a high proportion of recurrences. A total of 35

ankle ligament sprain injuries were reported, of which 14% (5/35) were recurrences. Although concussions were the most commonly reported diagnosis over the season (n=81), a smaller proportion were due to within season recurrence.

**Table 2. Injury Proportion Ratios for each diagnosis**

| | N recurrent | Total N recorded | IPR ł |
|---|---|---|---|
| Ankle ligament | 5 | 35 | 2.9 |
| Concussion | 4 | 81 | 0.9 |
| Lx muscle | 3 | 8 | 10.5 |
| Shoulder ligament | 3 | 31 | 1.5 |
| Knee ligament | 3 | 40 | 1.4 |
| Hand fracture | 1 | 12 | 1.6 |
| Hand ligament | 1 | 10 | 1.9 |
| Hamstring muscle | 1 | 16 | 1.2 |
| Hip/Groin muscle | 1 | 11 | 1.8 |
| Lower limb muscle | 1 | 5 | 4.4 |

ł A total of n=426 injuries were reported over the season, of which n =23 were recurrent

Muscle = muscle tear/partial tear/strain; Ligament = ligament tear/partial tear/sprain

**Discussion**

Patterns of subsequent injury have not yet been extensively evaluated in adolescent Rugby Union players. This is the first research reporting patterns and burden of subsequent injury using a large sample of adolescent rugby players. We found that of the 426 injuries reported over a single playing season, 28% were subsequent injuries. The majority of subsequent injuries were categorised as new (involving a different body part to the index injury), with recurrent injuries (injuries involving the same body region AND diagnosis as the index injury) being the next most common.

Overall, recurrent injuries comprised 5% of all injuries (23/426) occurring in a single playing season of U18 rugby union. This is lower compared to professional rugby where between 8% and 16% of all injuries are recurrent (2, 14). Only one previous study has reported on the prevalence of recurrent injury in schoolboy rugby.(10) Although they used a similar design to the current study, their recurrence figures were much higher at 11%. This disparity may be due to differences in recruitment as Palmer Green (10) focused exclusively on top tier schools (n=7) in England. In contrast, we used a more inclusive strategy, recruiting almost all rugby playing schools (28/32; 87%) within a single province of Ireland.

Almost 80% of recurrences happened within 2 months of returning to play. By comparison the prevalence of early recurrence in professional rugby is estimated at 40%.(9) Returning an athlete to full activity is a complicated and multifaceted process and can be influenced by a plethora of factors.(15) Amateur athletes, such as schoolboy rugby players, are less likely to consider key factors such as clinical criteria and psychological readiness, prior to making a return to play decision.(6)

Adolescents are also more likely to engage in risky or reckless behaviour(11) which may further contribute towards a premature return to play after initial injury. It is also possible that our high prevalence of early recurrence was due to incorrect diagnosis and/or inadequate rehabilitation; particularly as many of players in this study did not have easy access to qualified physicians or physiotherapists throughout the season.

Recurrent injuries to the lower back muscles, ankle sprains and concussion incurred the highest burden in our cohort. This somewhat aligns with professional rugby where the most common recurrent injuries involve the ankle and neck regions (9). There is also clear evidence from professional rugby that recurrent injuries are consistently more severe than new injuries.(2, 14) Using paired comparisons, we also found that on average recurrent injuries were associated with greater time loss injuries than index injuries (mean time loss of 45 days vs 25 days).

There were 81 concussions reported in our original study(5) of which 5% (4/81) were within season recurrences. Although these figures represent one of the lowest recurrence proportions in our cohort, they must be placed in context as sustaining multiple concussive blows in a short period of time can be catastrophic for young athletes. (16, 17) There is now clear evidence that having a history of previous concussion is one of the strongest and most consistent risk factors for future concussion(18) In the current study, all 4 cases of recurrence were preceded by convalescence periods of 23 days. This aligns with the minimum recommended recovery period in youth rugby union, however young athletes may be affected by more complicated recovery times and higher risk of adverse outcomes.(19) It is not clear if athletes in the current study followed a progressive rehabilitation protocol after their index concussion. In general, schoolboys may not be able to complete comprehensive concussion rehabilitation that encompasses neuromuscular control and cervico-vestibular challenges (20) without having regular access to medical experts in this field.

Ankle ligament sprains were the most frequent recurrent injury. In professional rugby, soft tissue injuries to the ankle have one of the highest recurrence proportions,(9) and in adolescent basketball, ankle sprains comprise 79% of all recurrent injuries(21). Recurrent ankle injury can be a feature of chronic ankle instability, which can lead to longer term problems including: decreased physical activity levels and increased risk of post-traumatic ankle osteoarthritis.(22) A recent meta-analysis found that exercise based rehabilitation significantly reduced the risk of recurrent injury after an acute ankle sprain (OR=0.59, 95% CI 0.51 to 0.68); with further risk reductions when higher durations of rehabilitation were employed (OR=0.48, 95% CI 0.37 to 0.63).(23) Again, supervised rehabilitation of lateral ankle sprain can be challenging within an amateur sporting environment. Various E-health rehabilitation solutions have been developed to help reduce the burden of recurrent ankle injury,(24) but it is not yet clear if these are as effective as physiotherapy led rehabilitation.

Although there were only 3 cases of recurrent lumbar muscle injury, these were each associated with significant time loss. In general, we found that lumbar injuries have a low prevalence in youth rugby,

comprising 6% of all injuries. (5) A recent cross sectional study(25) involving young athletes in field hockey, football and speed skating, estimated the 12-month prevalence of sports related low back pain to be 60%. As our primary focus was on time loss injury, it is possible that our figures under estimate the burden of overuse injuries to the lumbar spine. Indeed, it is not clear if athletes continued to train and play in spite of the presence of pain or functional limitations. A more valid quantification of injury burden may be achieved through more regular assessment of pain and full consideration of the affect that injury has on participation and sporting performance. (26)

**Limitations and recommendations**

Our primary focus was on recurrent injuries defined as athletes having more than one occurrence of exactly the same injury. This has provided an important breakdown of the patterns and burden of this particular subset of subsequent injury. We also highlight that the majority of subsequent injuries in our cohort involved different body parts to the index injury. Toohey et al.(27) have recently developed the second iteration of Finch and Cook's subsequent injury categorisation (SIC) model (12); central to this, is that correlations can also exist between index and subsequent injuries, without them being exactly the same. However, assessing these types of correlations requires access to detailed clinical notes; but this not possible in the current study. Indeed, as few school environments employ full time clinical staff, it will be challenging for future research to examine more complex aetiological pathways, such as those linking index and subsequent injuries that involve different tissue types or body parts. It may be that this level of etiological understanding can only be extrapolated from professional sports. Finally, medical verification occurred in 60% of injuries. The remainder were verified through the player, the coach or a parent; although this may have affected the accuracy of the diagnosis, this is not likely to affect the validity of other key injury data, for example, body part or time to return to play.

**Conclusion**

Subsequent injuries occur in schoolboy rugby with 1 in 10 players incurring more than 1 injury over a playing season. Three quarters of subsequent injuries involved a different body region to the index injury. We recorded n=23 recurrent injuries that involved the same body region and diagnosis as the index injury. Recurrent injuries made up 5% of all injuries and the cumulative time loss due to recurrent injury was 1073 days. Recurrent injuries involving the ankle ligaments, lumbar muscles and concussions carried the greatest burden and should be the focus for secondary prevention programs. Facilitating access to trained medical professionals and developing more valid return to play protocols could further reduce the burden of recurrent injuries in schoolboy rugby.

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